Lower Platte River Basin

The Lower Platte River is defined as the portion of the Platte River from its confluence with the Loup River to its confluence with the Missouri River. The Lower Platte River Basin (Basin) is defined as all areas that drain into the Lower Platte River with the exception of the Loup River Basin and the Elkhorn River Basin, Figure LP-1. Major streams in the Basin include Shell Creek, Salt Creek, and Wahoo Creek, Figure LP-2. The total area of the Basin is approximately 3,200 square miles and includes all of Saunders County and portions of Antelope, Boone, Butler, Cass, Colfax, Dodge, Douglas, Lancaster, Madison, Platte, Polk, Saline, Sarpy, and Seward counties. County seats in the Basin include Columbus, Fremont, Lincoln, Plattsmouth, Schuyler, and Wahoo.

Even though the portion of the Basin that falls within the Central Platte Natural Resources District has already been determined to be fully appropriated and was not reevaluated in that regard, the data relating to that area of the Basin had to be included in the analyses of the remaining portion of the Basin in order for the Department of Natural Resources to consider all relevant data in making the fully appropriated determination for the rest of the Basin.

Source of Water

Precipitation

Annual and growing season (May 1 through September 30) precipitation charts for gage sites in Columbus, Fremont, Lincoln, Plattsmouth, and Schuyler are shown on Figures LP-3 through LP-12. The average annual precipitation ranges from 26.8 inches at Columbus at the confluence of the Platte River with the Loup River to 29.8 inches at Plattsmouth at the confluence of the Platte River with the Missouri River. The average growing season precipitation ranges from 17.6 inches at Columbus to 19.1 inches at Plattsmouth. Locations of the precipitation gages can be seen in Figure LP-13.

Ground Water

The hydrogeology of the Basin is complex due to the glacial origin of the recent sediments. The entire Basin has been glaciated except for the western edge, Figure LP-14 (CSD 2005). For purposes of this report, all saturated unconsolidated sediments of Quaternary age above bedrock inclusive of the paleovalley alluvial aquifers where in hydrologic connection, the alluvial and the shallow aquifers, and the bedrock Tertiary Ogallala Group are combined into the principal aquifer unit for the Basin. Secondary aquifers are made up of the remaining bedrock aquifers. Tables LP-1 and LP-2 list the aquifers by age with the important hydrogeologic characteristics. The bedrock aquifers range in age from Tertiary to Pennsylvanian, Figure LP-15. The bedrock aquifers supply a small amount of water compared to the other aquifers but are an important source locally (CSD, 2005). They generally are not in hydrologic connection with the streams in the Basin.

The principal aquifer varies in saturated thickness from 0 to approximately 500 feet, Figure LP-16. Depth to water from the land surface varies from 0 to more than 200 feet, Figure LP-17 (CSD 2005). Transmissivity ranges from less than 20,000 gallons per day per foot (gal/day/ft) to more than 300,000 gal/day/ft. Most areas of the Basin have transmissivity of less than 20,000 gal/day/ft, Figure LP-18. Areas of higher transmissivity are generally related to the paleovalley alluvial aquifers. Specific yield ranges from less than 5 to greater than 20 percent, Figure LP-19. Due to the glaciated nature of the area, the principal aquifer is not always in hydrologic connection with the streams (CSD 2005). The ground water table, Figure LP-20, reflects the complicated nature of this glaciated area. Ground water tends to move from the uplands to the streams; however, the ground water contour map should not be taken as an expression of hydrologic connection (CSD 2005).

Ground Water Use

Ground water in the Basin is used for a variety of purposes: domestic, industrial, livestock, irrigation, and others. There are 10,649 registered ground water wells within

the Basin as of October 1, 2005 (Department registered ground water wells database). Not all wells are registered in the Department database, especially stock and domestic wells, which if drilled prior to 1993 are not required to be registered. Certain dewatering and other temporary wells are not required to be registered. Irrigation is the largest consumer of ground water, with approximately 600,000 acres being supplied with water from approximately 5,500 wells as of October 1, 2005 (Department registered ground water wells database).

Ground water development is limited within the Basin by the geology of the area. Figure LP-21 illustrates the location of depletive ground water wells. The areal extent of those wells indicates where ground water has been beneficially developed. Wells are mostly found in the paleovalleys and alluvial aquifers. Ground water development analyzed by comparison of completion dates has shown that development of high capacity wells (depletive wells capable of pumping more than 50 gallons per minute) has been steadily increasing with accelerated increases during the years 1954 to 1957, 1965 to 1981 and 2002 to the present, Figures LP-22, LP-23, and LP-24. Table LP-3 shows the estimated average irrigated acreage by county within the Basin between 1950 and 2003. The increase in the number of other depletive wells seen in Figures LP-23 and LP-24 after 1993 is attributed to revision of the well registration statute in 1993.

Changes in Ground Water Table Elevations

Figure LP-25 is a map made from a compilation of all ground water elevations reported to the Conservation and Survey Division of the University of Nebraska-Lincoln in cooperation with the U.S. Geological Survey and the Natural Resources Districts. It shows a small area in southeast Butler County with a decline of up to 30 feet in ground water table elevation from predevelopment through the spring of 2005. This area is adjacent to a similar area of decline in the Big Blue River Basin. Additional areas of declines can be seen in parts of Saunders, Cass and Lancaster counties. There is a large area of ground water increase in Northeast Boone and southwest Madison counties. Figure LP-26 is the location map for selected ground water hydrographs across the Basin. Figures LP-27 through LP-31 are hydrographs (USGS 2005) which give a representative

change in ground water table elevations for the particular area. Where possible a graph of a continuous recorder site is used.

Ground Water Management

The Basin primarily encompasses portions of four Natural Resources Districts (NRDs): the Central Platte NRD (CPNRD), the Lower Platte North NRD (LPNNRD), the Lower Platte South NRD (LPSNRD), and the Papio-Missouri River NRD (PMRNRD).

The CPNRD has established a ground water management area for both quality and quantity. As part of this management area, a permit from the NRD is required before the construction of a well pumping greater than 50 gallons per minute (gpm). The entirety of the CPNRD was determined to be fully appropriated in 2004. Due to this determination there is a stay on the issuance of NRD well construction permits and on the increase of ground water irrigated acres within the CPNRD portion of the Basin. Also, an integrated management plan is under development by the NRD and the Department for the entirety of the CPNRD.

The LPNNRD has established a ground water management area (GWMA) for quality purposes and the LPSNRD has established a GWMA for quality and quantity purposes. As part of the GWMA requirements in each of these NRDs, permits are required prior to the construction of wells pumping greater than 50 gallons per minute (gpm).

The PMRNRD has not established a GWMA.

Surface Water

Hydrographs from eleven surface water gages in the Basin are included in this report, Figures LP-32 through LP-42. They are Shell Creek near Columbus; Salt Creek at Roca, Lincoln, and Greenwood; Little Salt Creek near Lincoln; Stevens Creek near Lincoln; Rock Creek near Ceresco; Wahoo Creek at Ithaca; and the Platte River at North Bend, near Ashland, and at Louisville, Figure LP-43.

Surface Water Use

As of October 1, 2005, there are approximately 550 surface water appropriations in the Basin issued for a variety of uses. The majority of the surface water appropriations are for irrigation use and they tend to be located on the major streams. There are instream flow appropriations in the Basin along the Platte River. The first surface water appropriations in the Basin were permitted in 1897 and development has continued through present day. The largest period of development occurred in the 1970's, Figure LP-44 and Figure LP-45. The approximate locations of the surface water diversions are shown in Figure LP-46. Information on specific surface water appropriations is available in the Department's biennial report. Information on categories of use can be found in Appendix H.

Analyses for the Fully Appropriated Determination

Surface Water Administration

In the 108-year period since the first surface water appropriation was perfected in the Basin there have only been a few recorded instances of surface water administration in the administrative record, with the first occurring after 1975. The amount of surface water administration in the Basin has increased significantly since 1998, when the instream flow appropriations were granted. Table LP-4 shows the occurrences of water administration between 1985 and 2004. The junior surface water appropriations in the Basin had an average of 52.6 days in which surface water was available for diversion from July 1 through August 31 and 136 days in which surface water was available for diversion from May 1 through September 30.

Table LP-4. Water Administration in the Lower Platte River Basin between 1985 and 2004.

Year	Water Body	Days	Closing Date	Opening Date
2000	Lower Platte River Basin	53	Aug 8	Sep 30
2001	Lower Platte River Basin	11	Aug 7	Aug 18
2002	Lower Platte River Basin	6	Jun 6	Jun 12
2002	Lower Platte River Basin	67	Jun 25	Aug 31
2002	Lower Platte River Basin	24	Sep 6	Sep 30
2003	Lower Platte River Basin	81	Jul 11	Sep 30
2004	Lower Platte River Basin	13	May 6	May 19
2004	Lower Platte River Basin	7	Jun 29	Jul 6
2004	Lower Platte River Basin	58	Jul 27	Sep 23

The senior surface water appropriation that caused all of the administration in the Basin has a priority date year of 1993, therefore it is necessary to reconstruct the water administration table pursuant to the methodology in Appendix D, Table LP-5. Pursuant to the reconstructed table, there were an average of 37.2 days in which surface water was available for diversion from July 1 through August 31 and 112.6 days in which surface water was available for diversion from May 1 through September 30.

Table LP-5. Reconstructed Water Administration Table, Lower Platte River Basin, 1985 - 2004

Year	July 1 though August 31 Number of Days Available for Surface Water Diversion	May 1 through September 30 Number of Days Available for Surface Water Diversion
1985	44	130
1986	62	153
1987	47	138
1988	10	69
1989	14	47
1990	16	77
1991	6	66
1992	62	153
1993	62	153
1994	56	143
1995	52	134
1996	62	153
1997	40	131
1998	62	153
1999	61	152
2000	32	94
2001	28	111
2002	2	48
2003	6	72
2004	20	75
Average	37.2	112.6

Determination of Hydrologically Connected Area

No sufficient numeric ground water model is available in the Lower Platte River Basin to determine the 10/50 area or the lag impact of ground water wells.

The 10/50 area was determined using the Jenkins methodology as explained in Appendix D. Figure LP-47 shows the extent of the area considered to be hydrologically connected in accordance with Department rule 457 NAC 24.001.02 (Appendix A).

Lag Impacts

a) Current Well Development

The lag impact was computed using the Jenkins methodology documented in Appendix D. The results show that in the year 2030 an additional 15 cubic feet per second (cfs) of daily depletion can be expected from the Basin due to the effect of lag impact from existing wells. In addition, a depletion from the development of a senior surface water appropriation, the Metropolitan Utilities District wellfield, is estimated to be 160 cfs and affect streamflow at Louisville. The total calculated future depletion at North Bend includes the future depletion from the Loup River Basin (see Loup River Basin Chapter), and the Platte River and the total calculated future depletion at Louisville includes the future depletion from the Loup River Basin, Elkhorn River Basin (see Elkhorn River Basin Chapter), and the Platte River. The sum of those depletions results in a total depletion in the year 2030 of 110 cfs daily North Bend and 310 cfs daily at Louisville if there is no new well development.

The results found by comparing the senior surface water appropriation with the depleted daily flows (see methodology in Appendix D) show that in the future the average annual number of days in which surface water will be available for diversion to the junior surface water appropriations in the Basin will be 34.7 days from July 1 through August 31 and 109.0 days from May 1 through September 30 (Table LP-6).

Table LP-6. Water Administration Table with Current Ground Water Depletions, Lower Platte River Basin, 2011-2030

Year	July 1 though August 31 Number of Days Available for Surface Water Diversion	May 1 through September 30 Number of Days Available for Surface Water Diversion
2011	40	126
2012	59	150
2013	42	133
2014	6	64
2015	14	46
2016	14	75
2017	4	64
2018	61	150
2019	62	153
2020	51	136
2021	51	133
2022	62	153
2023	38	129
2024	61	150
2025	61	152
2026	26	87
2027	20	97
2028	1	44
2029	5	71
2030	16	67
Average	34.7	109.0

b) Future Well Development

Estimates of the number of high capacity wells that would be completed over the next 25 years if no new legal constraints were imposed on the construction of such wells were calculated based on extrapolating the present day rate of increase in well development into the future, Figure LP-48. For the past 20 years, the rate of increase in high capacity wells is nearly linear at a rate of 43 wells per year.

The lag impact was computed for the projected wells using the Jenkins methodology documented in Appendix D. The results show that in the year 2030 an additional 50 cfs of daily depletion due to ground water pumping can be expected at North Bend and an additional 55 cfs of depletion due to ground water pumping at Louisville if there were new well development in the Basin. In addition, a depletion from the development of a

senior surface water appropriation, the Metropolitan Utilities District well field, is estimated to be 160 cfs and affect streamflow at Louisville.

The result of the future development depletions can be quantified the same way as with the current depletions. The sum of the depletions with future development results in a total depletion in the year 2030 of 270 cfs daily at North Bend and 530 cfs daily at Louisville.

The results found by comparing the senior surface water appropriation with the depleted daily flows show that in the future, with no restrictions on well development, the average annual number of days in which surface water will be available for diversion to the junior surface water appropriations in the Basin will be 33.1 days from July 1 through August 31 and 105.5 days from May 1 through September 30, Table LP-7.

Table LP-7. Water Administration Table with Current and Future Ground Water Depletions, Lower Platte River Basin, 2011-2030

Year	July 1 though August 31 Number of Days Available for Surface Water Diversion	May 1 through September 30 Number of Days Available for Surface Water Diversion
2011	39	123
2012	56	147
2013	39	130
2014	5	60
2015	14	44
2016	11	72
2017	3	63
2018	59	142
2019	62	153
2020	47	127
2021	49	126
2022	61	152
2023	38	129
2024	61	146
2025	61	152
2026	20	81
2027	15	89
2028	1	42
2029	4	69
2030	16	62
Average	33.1	105.5

Future Surface Water Development and Uses

The number of surface water appropriations in the Basin has grown steadily over the past 30 years and it appears reasonable to project that that trend will continue into the future, Figure LP-44. The number of acres permitted for surface water irrigation also has grown steadily for the past 30 years, Figure LP-45, and no significant changes to that rate of growth are expected in the future. However, surface water development must be limited to ensure compliance with the Nebraska Nongame and Endangered Species Conservation Act (NNESCA) due to the presence of Pallid Sturgeon and Sturgeon Chub in the Lower Platte River. The Department and the Nebraska Game and Parks Commission have a policy regarding the procedure for issuing new surface water appropriations and amending existing appropriations so that NNESCA will be complied with. This policy limits the number of surface water appropriations that can be issued without further study of the effects on these species.

Ability to Satisfy Net Corn Crop Irrigation Requirement

Figure LP-49 shows the net corn crop irrigation requirement for the Basin. The map shows the net corn crop irrigation requirement to be 9.0 inches or less across the Basin. Assuming a surface water diversion rate equal to 1 cubic foot per second per 70 acres and a downtime value of 10 percent; depending on the location in the Basin, it takes approximately 23.9 days annually to divert 65% of the net corn crop irrigation requirement from July 1 through August 31 and approximately 31.3 days to divert 85% of the net corn crop irrigation requirement from May 1 through September 30.

The reconstructed surface water administration analysis showed an average of 37.2 days in which surface water was available for diversion from July 1 through August 31 and an average of 112.6 days in which surface water was available for diversion from May 1 through September 30. The number of days in which surface water was available for diversion in both the July 1 through August 31 and the May 1 through September 30 time frames exceeds the number of days surface water is required to be available for the

greatest net corn crop irrigation requirement for the junior surface water appropriations in the Basin during those same periods.

Sufficiency of Surface Water Supply [Nebraska Revised Statutes Section 46-713(3)(a) (Reissue 2004)]

The average number of days in which surface water was available for diversion in both the July 1 through August 31 and the May 1 through September 30 time frames required by Department rule 457 Nebraska Administrative Code (NAC) 24.001.01 exceeds the number of days surface water is required to be available pursuant to the rule during those same periods. The lag impact analyses show that even in the future, the number of days in which surface water will be available for diversion in both time periods will exceed the number of days surface water would be required to be available. Table LP-8 summarizes the results of comparisons between the number of days surface water must be available to meet the 65% and 85% net corn crop irrigation requirements and the number of days in which surface water was available for diversion to the junior surface water appropriations.

Table LP-8. Summary of Comparison Between Net Corn Crop Irrigation Requirement and Number of Days Surface Water is Available for Diversion.

	Number of Days Necessary to Meet the 65% and 85% of Net Corn Crop Irrigation Requirement	Average Annual Number of Days Available to the Junior Surface Water Appropriations (1985-2004)*	Average Annual Number of Days Available in 2030 with no Additional Well Development	Average Annual Number of Days Available in 2030 with Additional Well Development
July 1 – August 31	23.9	37.2 (13.3 days above the requirement)	34.7 (10.8 days above the requirement)	33.1 (9.2 days above the requirement)
May 1 – September 30	31.3	112.6 (81.3 days above the requirement)	109.0 (77.7 days above the requirement)	105.5 (74.2 days above the requirement)

* From the reconstructed administration record.

Sufficiency of Streamflow for Ground Water Supply [Nebraska Revised Statutes Section 46-713(3)(b) (Reissue 2004)]

Since the criteria for Nebraska Revised Statutes Section 46-713(3)(a) were satisfied, the conclusion for this section is the same for reasons explained in the report introduction.

Sufficiency of Surface Water Supply for Compliance with Compacts or State Laws [Nebraska Revised Statutes Section 46-713(3)(c) (Reissue 2004)]

There are no compacts on any portions of the Lower Platte River Basin in Nebraska. At this time there is sufficient water supply in the Basin to comply with NNESCA and, as discussed above, future development will be limited so as to continue compliance.

Future Development of Surface and Ground Water [Nebraska Revised Statutes Section 42-713(1)(b) (Reissue 2004)]

Given the rate of registered ground water well and surface water appropriation development, the conclusion that the Basin is not fully appropriated would not change even if no additional legal constraints were placed on development and a reasonable projection of a continuation of the current trend of well development of the last 20 years is used.

Conclusions

Excluding the portion of the Basin that includes CPNRD, which has already been determined to be fully appropriated and was not reevaluated in this report, there is no evidence that current ground water depletions to streamflow in the Basin are affecting surface water users sufficiently to meet the criteria for being fully appropriated as found in Department rule 457 NAC 24.001.01 when compared to the amount of surface water available at the present time.

There is no evidence available at this time that lag impact will be sufficient in 25 years to affect existing water users enough to meet the criteria for being fully appropriated as found in Department rule 457 NAC 24.001.01.

Based upon available information and its evaluation, the Department has reached a determination that the Basin is not fully appropriated. The Department has also determined that even if no additional legal constraints are imposed on future development of hydrologically connected surface water and ground water and reasonable projections are made about the extent and location of future development, this conclusion would not change.